Improving the teaching of science and technology in primary schools — a cluster approach

Paul Chambers reviews a programme of primary science professional development that has been operating in Scotland for a number of years and discusses its effectiveness in light of the review of the programme recently undertaken by the Robert Owen Centre for Educational Change

The position of science and technology in Scottish primary schools is broadly similar to most other primary schools throughout Great Britain. There are certain schools and individuals that perform at a very high level but many schools are hampered by a lack of resources, a lack of confidence in teaching the topics and some significant gaps in the teachers’ own subject knowledge. We can all recall reports and surveys identifying a number of reasons as to why the current situation exists.

As recently as 2014, the Learned Societies’ Group on Scottish STEM Education, of which the Association for Science Education is a member, reported that resourcing was a key issue (LSG, 2014); the spending of many authorities had not increased and almost half of Scottish primary schools had no access to basic science equipment (tongs, mats, goggles etc.). Allied to a lack of familiarity with the equipment, this would lead to experiments being avoided.

The publication in 2011 of Teaching Scotland’s future, a review of teacher education (it is called teacher education in Scotland, not teacher training) by former Head of Her Majesty’s Inspectorate of Education (HMIE), Professor Graham Donaldson, gave additional stimulus to addressing weaknesses in current teacher education courses and also to career-long teacher education (Donaldson, 2011). The report makes interesting reading and, like all documents of this type, makes a number of recommendations. Those of interest to this article are given in Box 1.

Alongside the Donaldson review, the Science and Engineering Education Advisory Group was reporting on what Scotland requires of its education system in order to provide suitably qualified young people who are aware of the roles science and engineering play in our society and who are suitably educated so that they can become part of this in Scotland’s future (SEEAG, 2012). The report echoed the need for better or more suitably qualified teachers in order for Scotland to retain and enhance its capability in STEM subjects (science, technology, engineering and mathematics).

Planning improvement

In response to the above reports, a group representing SSERC (see Box 2), the Local Authorities, Scottish Government and the National STEM Learning Centre (NSLC) met in 2011–2012 to formulate a plan. It was decided that high-quality CPD was required to address some of the issues (mainly curricular knowledge and practical/pedagogical approaches) but that it also had to be sustainable.

Box 1 Some recommendations from Teaching Scotland’s future (Donaldson, 2011)

- **Recommendation 12:** Increased emphasis should be given to ensuring that primary students have sufficient understanding of the areas they are expected to teach. …
- **Recommendation 33:** The balance of CPD activities should continue to shift from set-piece events to more local, team-based approaches which centre around self-evaluation and professional collaboration, and achieve an appropriate blend of tailored individual development and school improvement.
- **Recommendation 42:** Teachers should have access to high-quality CPD for their subject and other specialist responsibilities.

Key words: Scotland CPD Cluster approach
Box 2 SSERC

The Scottish Schools Education Research Centre (SSERC, www.sserc.org.uk) plays a significant role in the areas of STEM education and continuing professional development (CPD). It is a Local Authority shared service (all contribute to its operation) and supports all 32 Scottish Education Authorities. Its services are available to teachers, student teachers, technicians, schools, colleges and initial teacher education providers. It provides health and safety advice and professional development programmes for school staff.

and lead to changing practices within schools.

The plan that was formulated chose to take a ‘cluster’ approach. A cluster in this sense is a group of primary schools and their associated secondary school. The practice in Scotland is that children from a group of primary schools all attend the same secondary school. There are no grammar schools or academies that parents vie to get their children enrolled in as in England. The cluster approach was seen as a key issue. If the ‘science’ input was consistent across a primary cluster, the secondary school could be involved and try to address issues such as lack of demand in year 1 or cohesion across the sectors.

Piloting the new approach

A pilot scheme was run in 2012 and involved two clusters: two secondary schools and their associated primary schools. A number of staff in primary schools across the cluster were selected to be STEM mentors. These mentors, approximately six per cluster, attended a three-day residential course at SSERC headquarters in Dunfermline. The course was intensive and addressed issues of investigative approaches, subject-specific knowledge, curriculum management and practical work in science. It also had a strong teacher-mentoring input and included sessions on teacher development in a professional context and reflective analysis of practice.

Alongside this, a cluster management group was established, including head teachers or senior management team members from the cluster primary schools and associated secondary school. There was a commitment that the cluster would change teaching practices during the course of the pilot. SSERC were not involved in this but were invited to attend to describe their participation before fully committing to the project.

The cluster management group and the mentors worked together to audit their current provision and identify what they needed in order to improve their position in the STEM area. They then designed a series of plans of what they would have to do in order to achieve their goals (Box 3).

SSERC invited a number of suitable individuals and organisations to design and deliver high-quality workshops/CPD events that could be used to assist clusters in implementing their plan(s). My personal involvement in this project was as a deliverer of ‘high-quality CPD’. I identified five topics in my area of expertise where I felt I could assist clusters in achieving their targets and a number of other providers did the same. These covered a wide range of topics such as:

- biodiversity;
- teaching forces and other tricky stuff;
- moving objects by attraction and repulsion;
- topical science;
- solutions and stuff.

Funding for the CPD sessions was provided via the Scottish Government and the National STEM Learning Centre. SSERC managed the finance and resources for these CPD sessions and, if I was asked to present at a cluster, I would teach the topic and then invoice the cluster for my time. The resource management involved the cluster planning a programme of CPD that included a number of workshops. The programme, including costs, was submitted to SSERC. When approved, SSERC released funding to the cluster who then paid the provider.

SSERC ensured all participants completed a thorough evaluation of their CPD; this was then collated and each provider received a summary of their ‘quality’ at the end of the year.

From my viewpoint, these CPD events were interesting. On one occasion, an in-service day, I travelled to a primary school that was hosting all the staff from their cluster of five primary schools; there were approximately 80 staff in attendance. I was ‘hired’ to deliver two 90-minute sessions on ‘Our Calendar, Seasons and Space’ to an audience of around 20 staff. There were also four other science sessions running that morning and staff had decided which sessions they would attend. Science staff from the associated secondary school were also taking part.

This event ensured a wide range of staff from across the cluster had received additional CPD and that the schools within the cluster had a record of who attended which sessions and therefore what expertise they had ‘gained’. The clusters also had a collegiate

Box 3 An example of part of an improvement plan

An example of what may be included in a wider plan would be:

Goal: Improve the provision of the schools in the cluster in their teaching and learning of electrical phenomena

- Identify the training and development required in order for staff to be able to teach the topic across the school effectively.
- Source high-quality CPD to deliver the training and development input.
- Apply for funds from the Primary Cluster Programme to support the CPD for the cluster.
- Plan and design the activities for the school based on the improved knowledge, confidence and resources available.
- Professionally evaluate the learning and teaching and identify how practice has changed.
- Promote and share this practice within the cluster.
feel: staff were making links and contacts across the cluster, sharing expertise, experience and resources.

Moving on

The pilot scheme was very well received in terms of evaluations from staff and the cluster management groups. It was expanded the following year (2013–2014) and rolled out more widely in 2014–2015.

In 2014–2015, 17 different clusters and over 1200 staff participated, representing 11 Local Authorities. These staff were involved in a number of CPD events throughout the year. Some were traditional events similar to the one described above and others were interactive e-learning events with virtual meetings. There were just under 4000 attendances at these events. The most recent data for 2015 gives an overall total of 21 Local Authorities, 56 clusters, 313 schools, 2400 teachers and 8300 attendances.

It is hoped the programme will continue and eventually be available to the vast majority of schools and staff across Scotland.

How effective is it?

This is the crux of the matter. There have been many schemes over the years to improve the teaching and learning of STEM in primary schools. Many have an immediate impact but do they ultimately change existing methodology and embed STEM in the schools?

The Robert Owen Centre for Educational Change (University of Glasgow) published an evaluation of the Primary Cluster Programme in November 2015 (Hall and Lowden, 2015). This was a comprehensive evaluation of the project with data gathered from teacher mentors, head teachers/cluster management groups, teachers involved in the project and Local Authority officers. The report is comprehensive and evaluated many issues relating to the project such as teacher mentoring, career-long professional learning, provision of science and technology learning and teacher confidence.

The report is very positive and shows clearly that the programme is having a significant impact on the science and technology experienced by young children in the clusters and that there is an increasing engagement with STEM.

In attempting to analyse why the programme has been successful the report identified a number of activities that contribute to this:

- The willingness of mentors and staff to undertake career-long professional learning is an important driver. This, allied to achievable curricular aims and measurable improvements in provision, appear to have been effective. CPD that can then be translated into changes in practice and supported by resources, not surprisingly, appears appropriate.
- The focus, delivery and content of the CPD sessions was commended. It was seen as appropriate, increased the recipients’ confidence in teaching the topics, provided new contexts for their teaching and encouraged them to attend more CPD events of this type.
- The collegiality and the knowledge that there were colleagues in the cluster attempting similar programmes was seen as a strength. Networking and sharing of practice, allied to a more rigorous system of evaluating, contributed to teachers feeling more confident in adopting new practices and less concerned when there were teaching difficulties. The role of the mentors in providing a platform for discussion, advice and so on was crucial. For example, a mentor-led session following a CPD event was seen as helpful in the detailed classroom planning and assessing.
- The evaluation goes into much more detail but some of the key strengths have been discussed here. The recommendations of the report may appear obvious in the light of what has been written but they include:
  - sustaining and expanding the programme;
  - building on the initial impact;
  - more work in enhancing primary and secondary partnerships;
  - expanding this to early years.

Can it be expanded?

There are just over 2000 primary schools in Scotland with over 23,000 teachers. There are about 360 secondary schools. If we assume one secondary school per cluster this leads to 360 clusters. The investment required to expand would be considerable. The model does appear to work, however, so can we afford not to?

References


Could this model be adapted to other education systems?

I think so but there are a number of issues:

- The link between primary schools and associated secondary schools is crucial. If that does not exist, the curricular benefits regarding the transition from sector to sector may be reduced (and possibly the collegiality).
- The scale and sheer numbers outside Scotland would cause its own problems.
- The need for an equivalent body to SSERC to manage such a project.

Paul Chambers is a senior lecturer in science education at the University of Strathclyde.

Email: p.chambers@strath.ac.uk